Search for a diffuse emission of neutrinos from Local Bubbles with the ANTARES telescope

Luigi Antonio Fusco – luigi.fusco@apc.in2p3.fr
Laboratoire APC, Paris

on behalf of the ANTARES Collaboration

1. Introduction

The **ANTARES** detector [1] is the largest and longest operated underwater neutrino telescope, located in the Mediterranean Sea, 40 km off-shore Toulon, France, at a depth of ~2500 m.

Its location and energy threshold allow studying galactic neutrino emission scenarios [2].

All-flavour neutrino interactions can be properly reconstructed and used in the analysis [3].

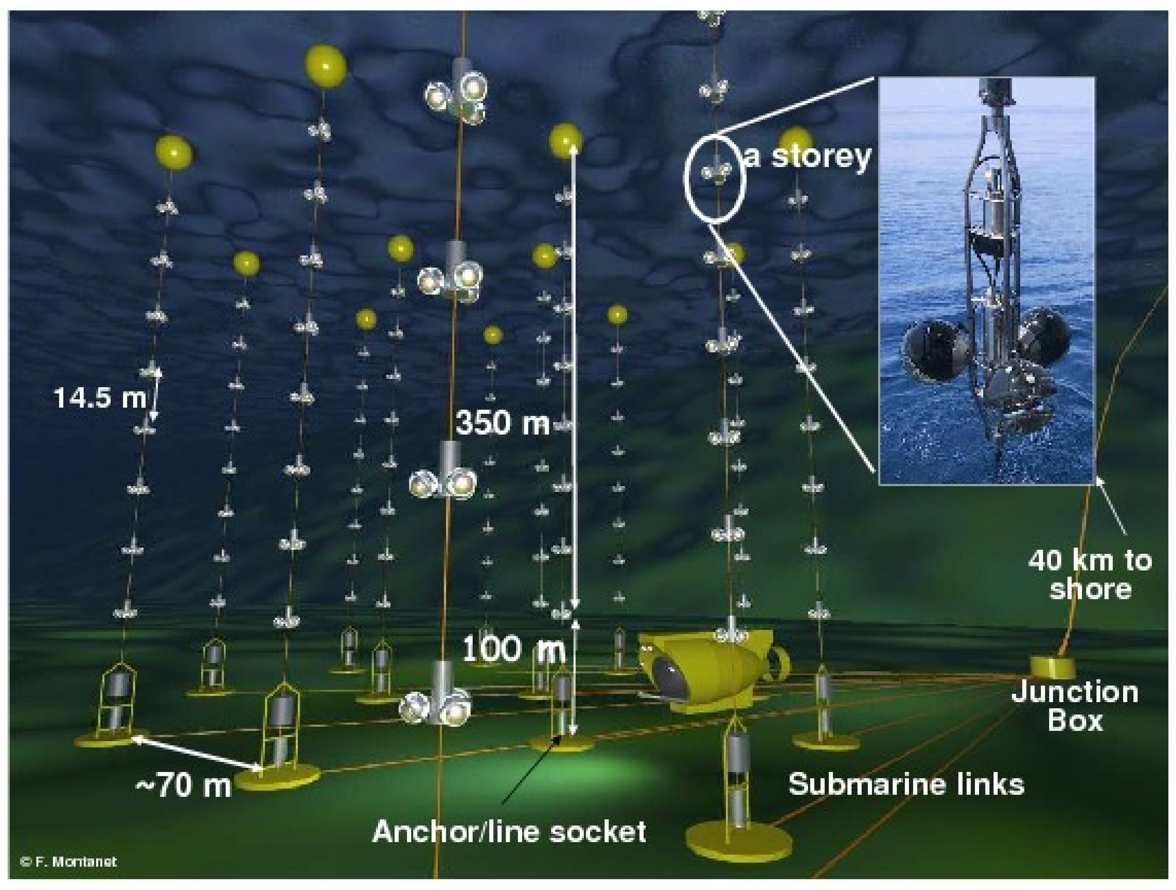

Figure 1. Pictorial view of the ANTARES detector.

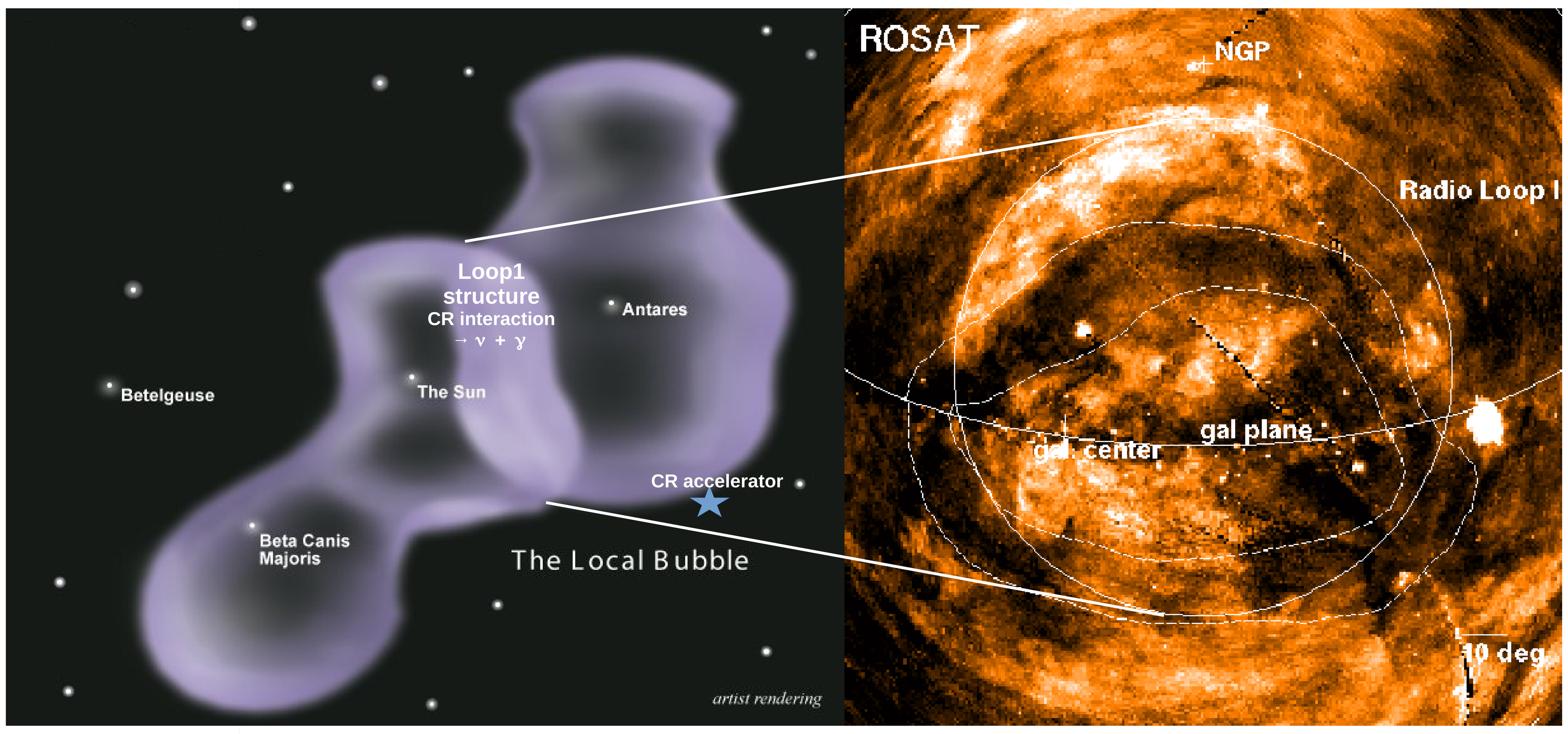

Figure 2. Left: schematic view of the production scenario. Right: Rosat-Xray map of the Loop1 region.

2. Neutrinos from Galactic Superbubbles

Neutrinos can be produced by cosmic rays (CRs) via the consequent pion decays.

A young CR accelerator interacting with the inhomogeneities in matter density and magnetic fields induced by local superbubbles can lead to enhanced neutrino emission from extended regions of the sky [4].

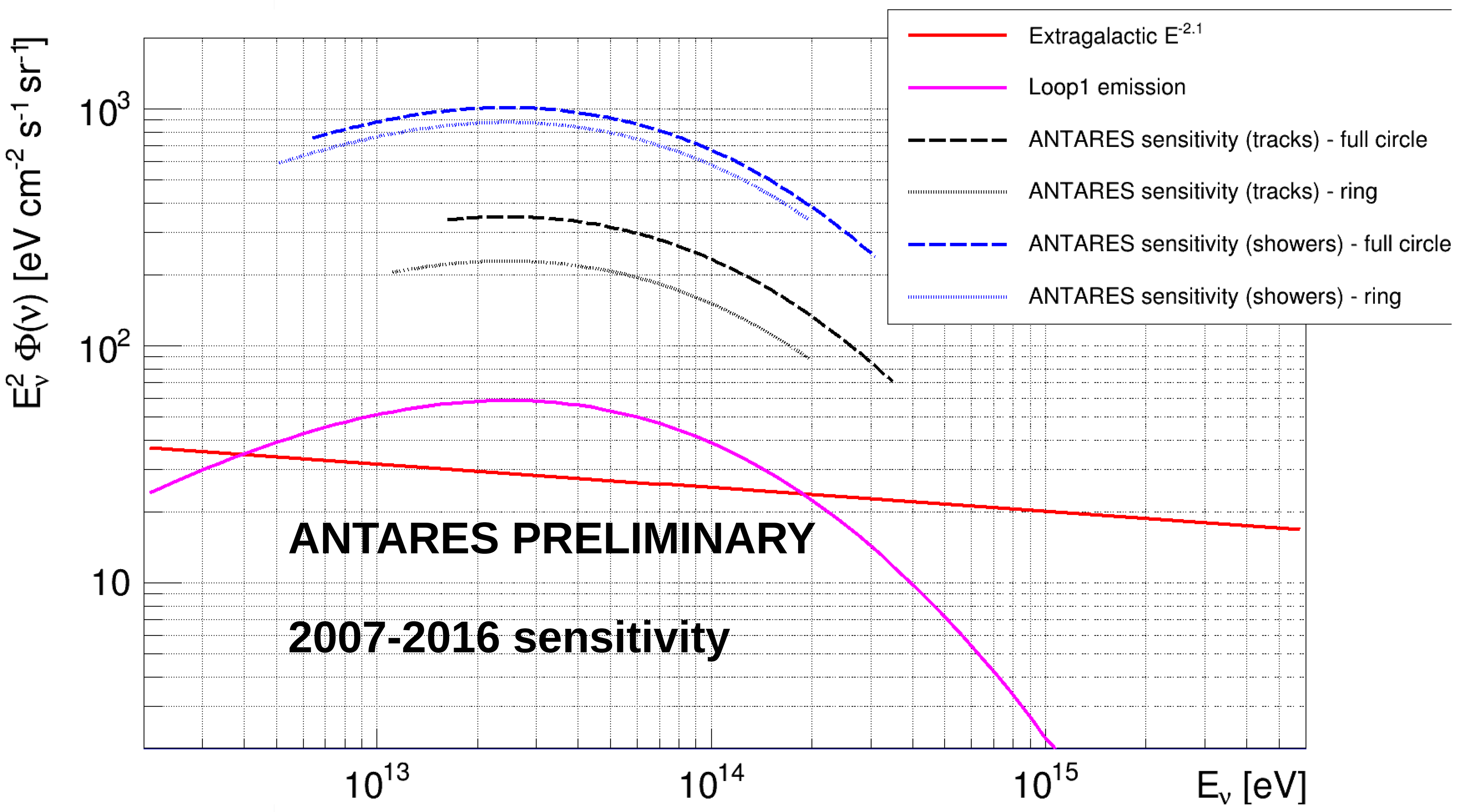

Figure 3. Expected flux from modelisation of the cosmic signal observed by IceCube according to Ref. [4] compared with the sensitivity of ANTARES (2007-2016 equivalent data livetime) to the flux of the Loop1 emission under the two considered emission regions.

	MRF tracks	E-range tracks	MRF showers	E-range showers
Full circle	5.95	16 – 355 TeV	17.2	6.3 – 315 TeV
Ring	3.87	11 – 200 TeV	14.9	5 – 200 TeV

Table 1. Summary of sensitivities (in terms of MRF from the flux of [4]) and energy range for ANTARES in the two considered options for Loop1 neutrino emission

3. Neutrino analysis optimisation

1) Tracks: CC interactions of **muon neutrinos**

→ pointing and good rejection of the atmospheric muon background

2) Showers: **All-flavour** neutrino NC interactions and ν_eCC

→ worse angular resolution; optimal energy reconstruction.

The MRF [5] procedure is considered to optimise event selection for the best sensitivity.

The quality parameters of the reconstruction algorithms are used for the atmospheric background rejection, while an energy cut allows an optimisation of the neutrino signal-to-noise ratio.

A **full circle** encompassing the whole Loop1 region (60° in radius, centred at l = -30°, b = 17.5°) and a 10°-thick **ring** are considered as possible emission topologies.

4. Conclusions and outlook

ANTARES sensitivity are presented in figure 3 and table 1.

These values show the overall reach of ANTARES in the search for extended emission regions. These are not in reach for possible modelisation: the sensitivity might be increased in case of a more localised topology as observed in the X-ray map of the region. Improved studies are ongoing to cover this option.

References

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[4] K.J. Andersen et al., arXiv: 1712.03153 (2017).
[5] G.C.Hill & K.Rawlins, Astropart. Phys. **19**: 393 (2003).